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Ishizaka et al.

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[54] **LUBRICATING OIL FEEDING APPARATUS AND OIL FEEDING STRUCTURE FOR STARTER DRIVEN GEAR BEARING IN INTERNAL COMBUSTION ENGINE**

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[21] Appl. No.: **435,167**

[22] Filed: **May 5, 1995**

Related U.S. Application Data

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[30] **Foreign Application Priority Data**

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Aug. 30, 1993	[JP]	Japan	5-237405

[51] **Int. Cl.**[6] **F01M 1/06**

[52] **U.S. Cl.** ..... **123/179.25**; 123/179.29; 123/196 R; 184/5; 184/6.3

[58] **Field of Search** ..... 123/196 R, 179.22, 123/179.24, 179.28, 179.29, 179.25; 184/5, 6.3

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Primary Examiner—Henry C. Yuen
Assistant Examiner—Evick Solis
Attorney, Agent, or Firm—Birch, Stewart, Kolasch & Birch

[57] **ABSTRACT**

A lubricating oil feeding apparatus of an internal combustion engine can adjust an amount of oil fed to each bearing and provides for a reduced number of parts for a shaft portion structure of a starter driven gear. In the engine, a balancer shaft is synchronously rotated with a crankshaft. The crankshaft and the balancer shaft are rotatably supported on a split surface of a crankcase by plain bearings. Parallel oil passages communicate with oil holes provided in the plain bearings for exclusively feeding lubricating oil to at least the crankshaft and the balancer shaft. The opening areas of the oil holes provided in the plain bearings of the balancer shaft are smaller than the oil holes provided in the plain bearings of the crankshaft. An outer portion of a starter one-way clutch can also be integrally fitted on a rotor. A driven gear of the starter is connected to a starter drive gear of a starter motor by intermediate gears. The diameter D_b of a starter driven gear bearing portion of the crankshaft is the same as the diameter D_a of a supporting portion of the crankshaft. A starter driven gear of the starter one-way clutch is fitted to the starter driven gear bearing portion of the crankshaft by a slide bearing to be freely rotated relative to the starter driven gear bearing portion. A lead groove is provided on the inner surface of the bearing for positively feeding oil to the receiving surface of the slide bearing.

2 Claims, 13 Drawing Sheets

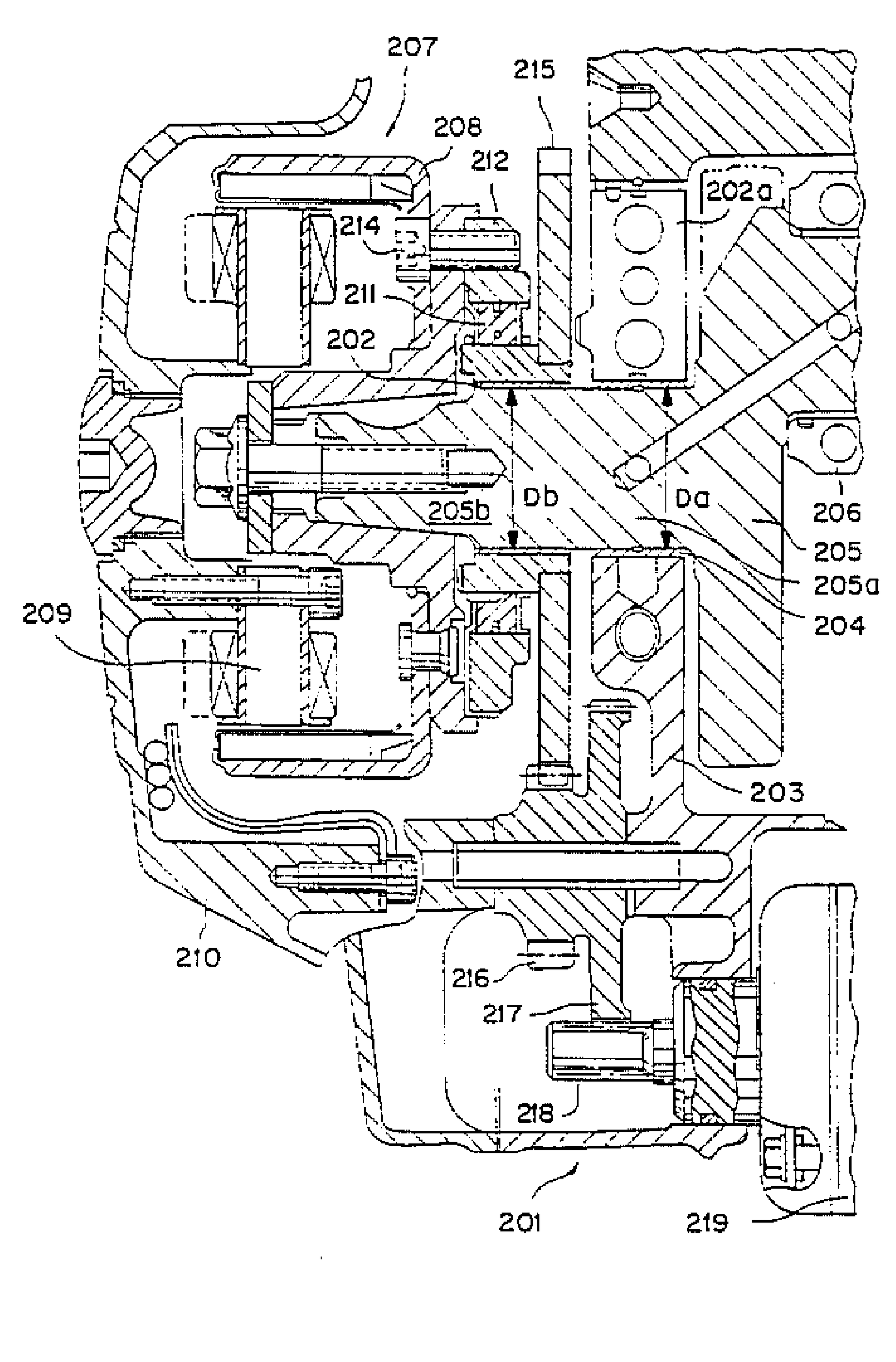
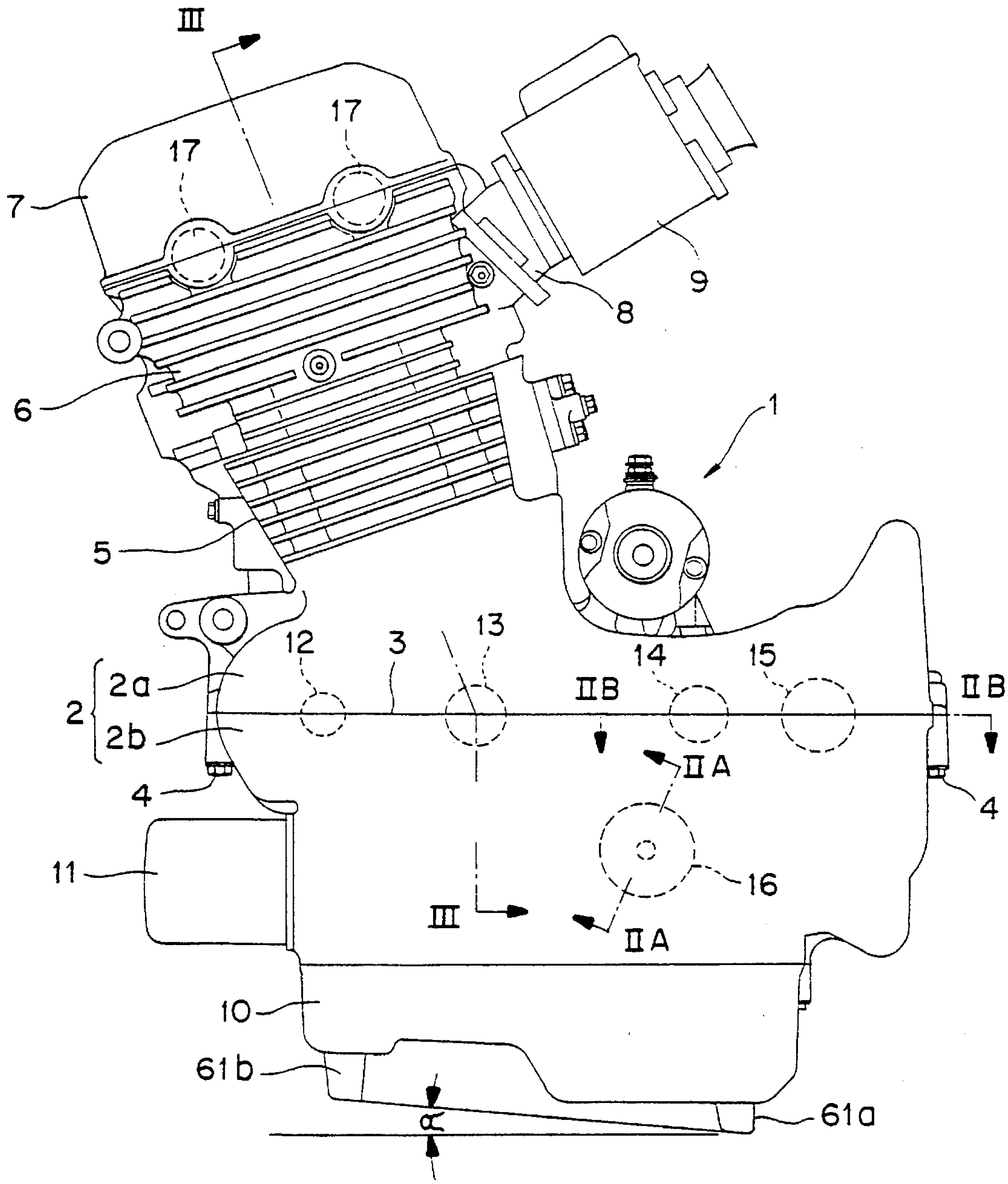


FIG. 1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12
3
13
2a
2
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IIB
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IIA
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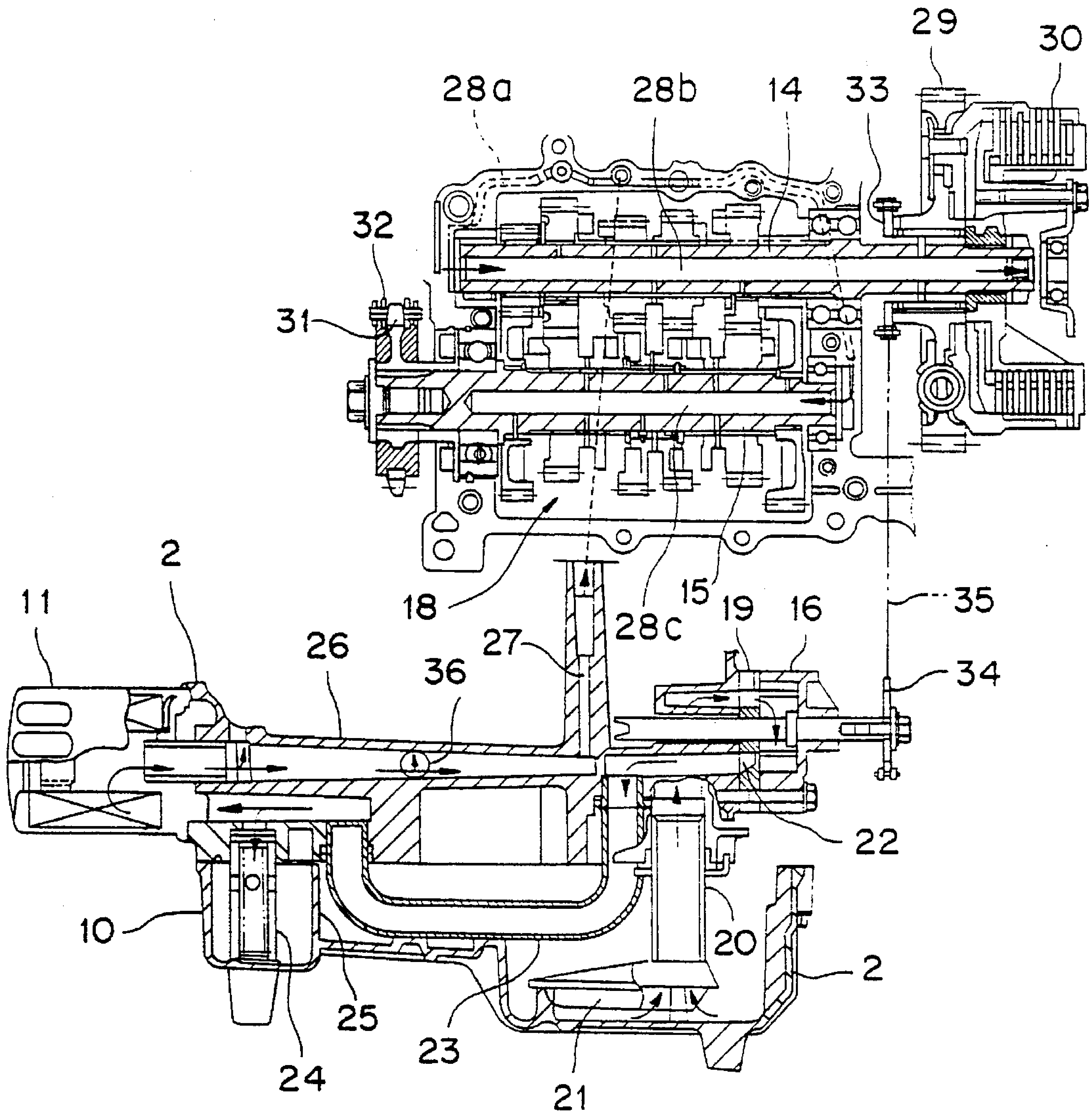
61b
α
61a

FIG. 2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28a
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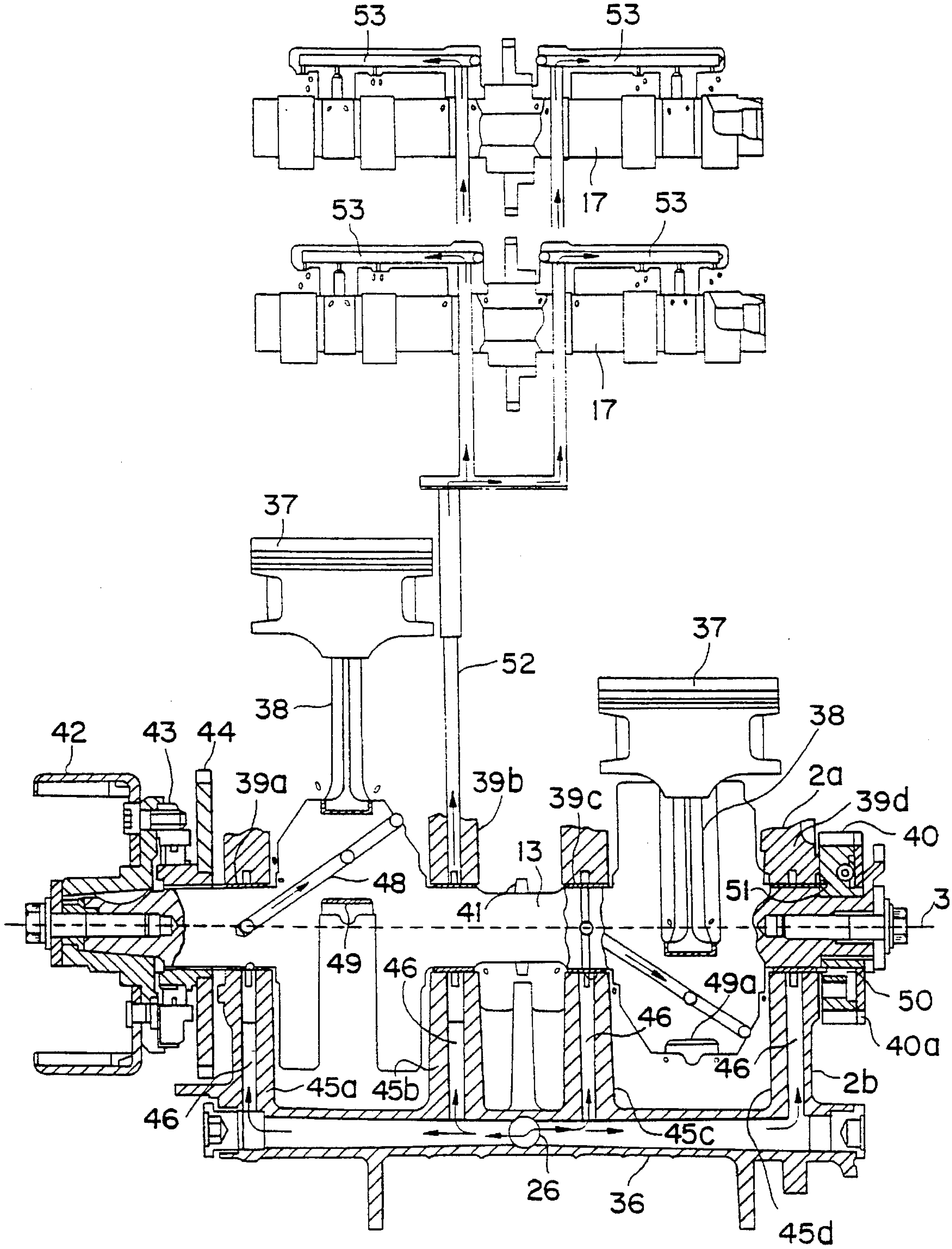
FIG. 3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13
48
41
51
3
49
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49a
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40a
46
45a
45b
2b
46
45c
26
36
45d

FIG. 4

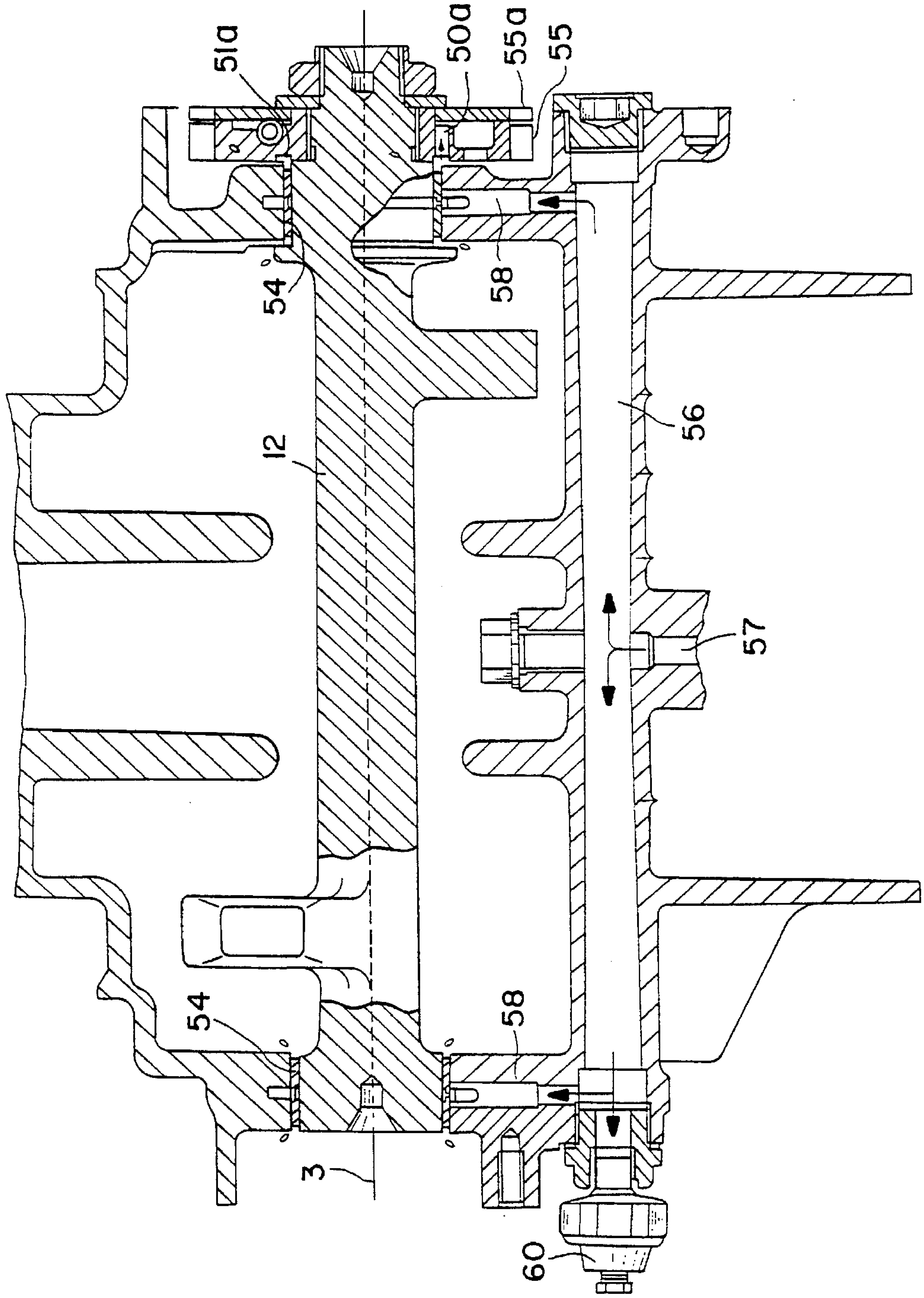


FIG. 5

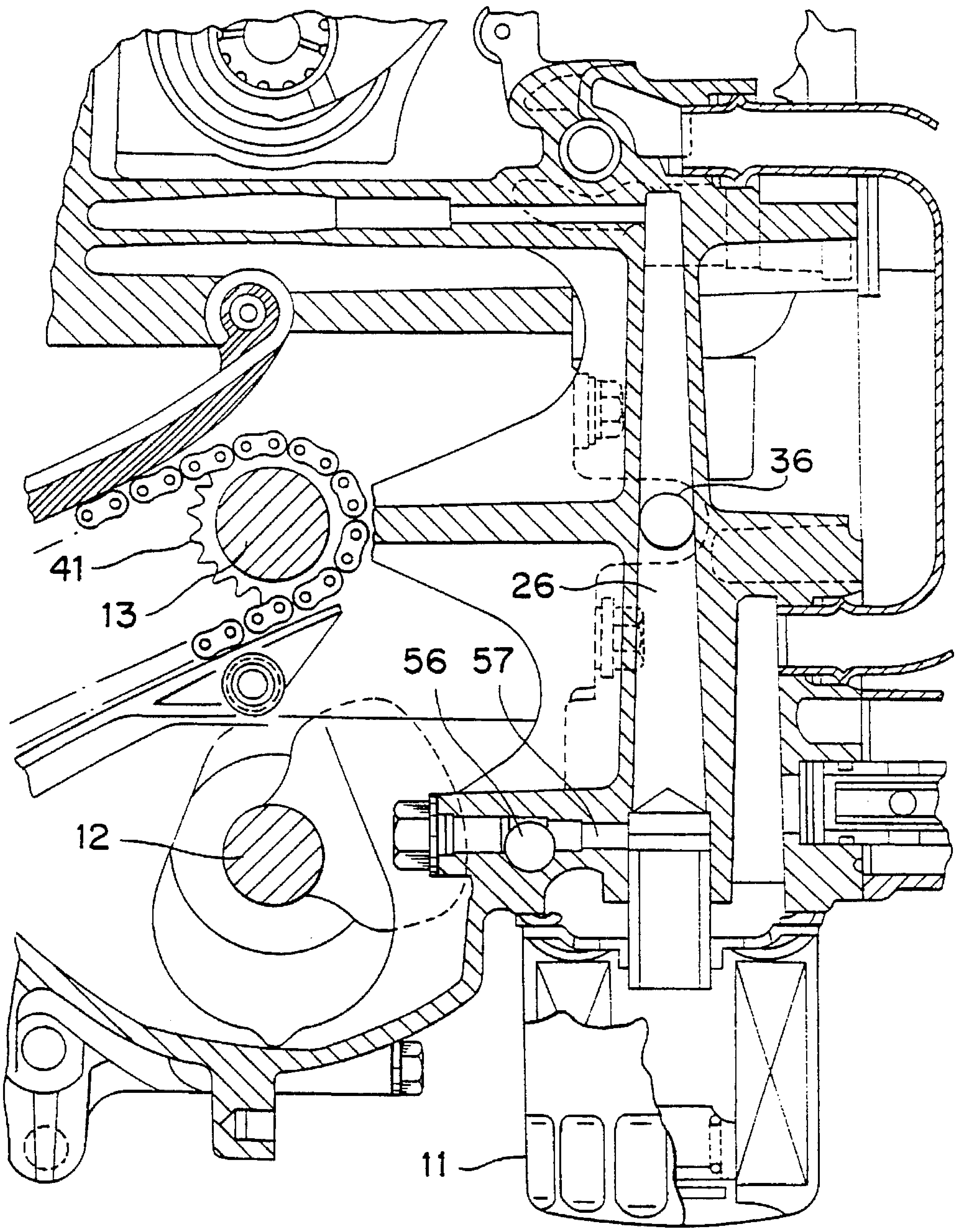


FIG. 6

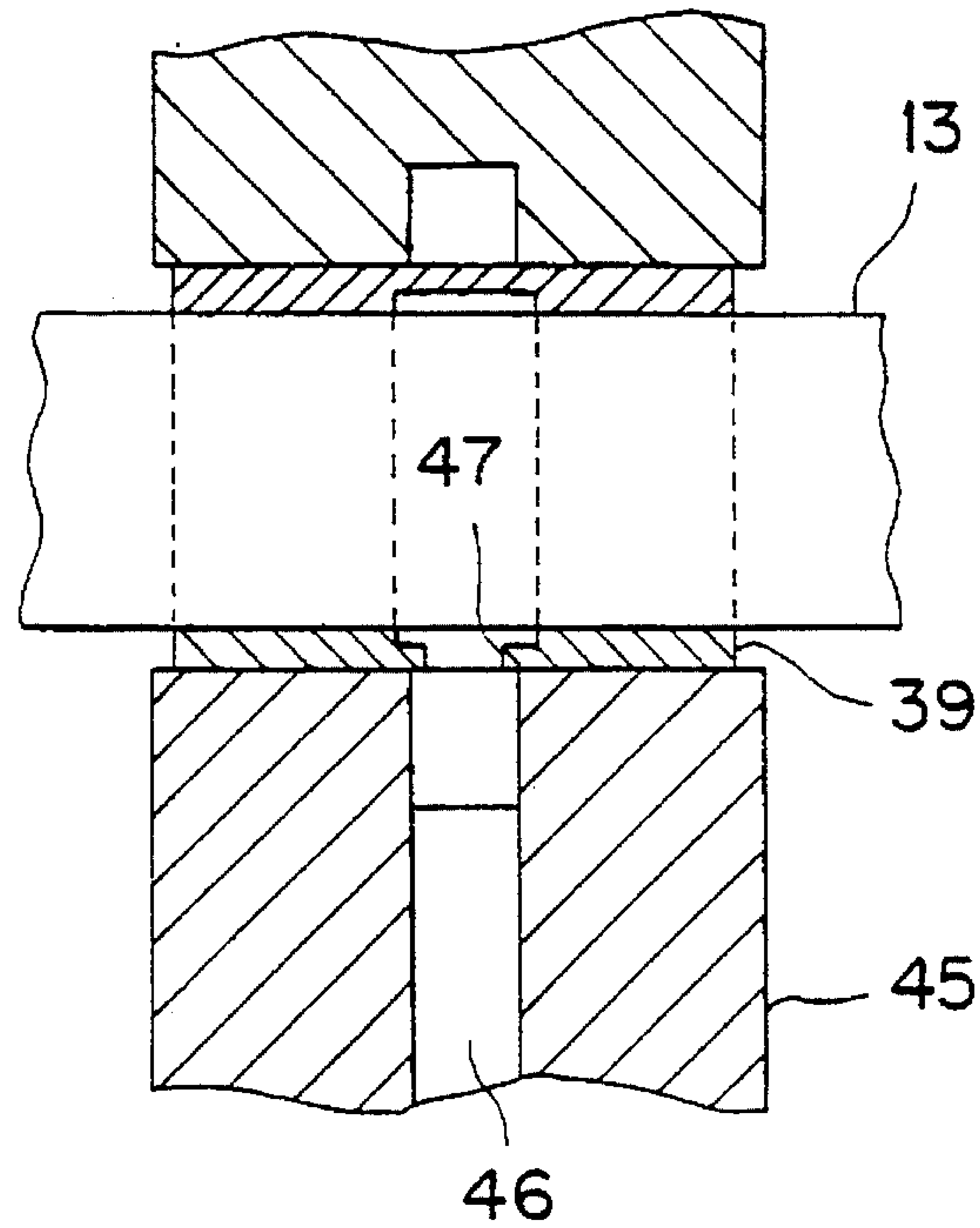


FIG. 7

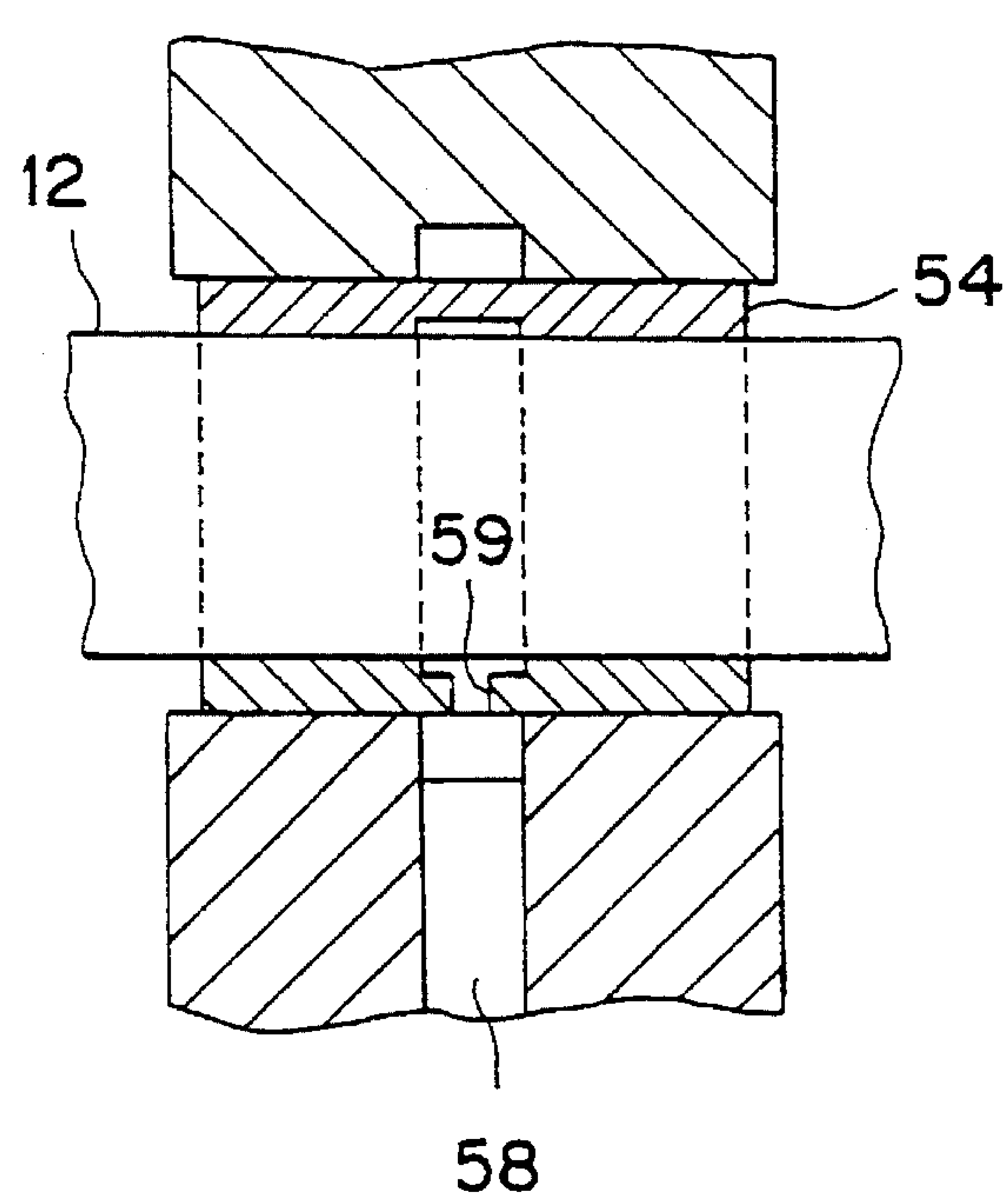


FIG. 8

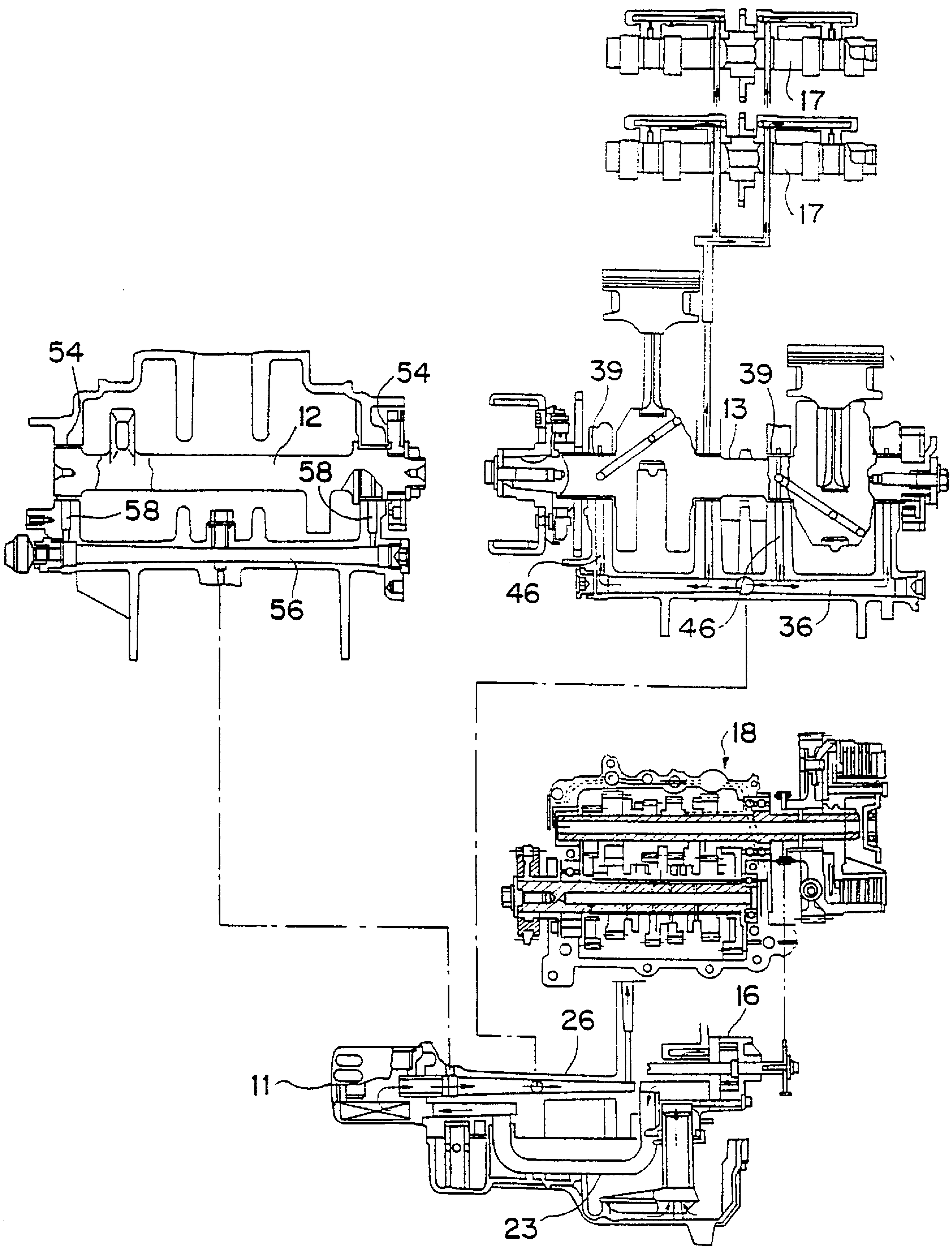


FIG. 9

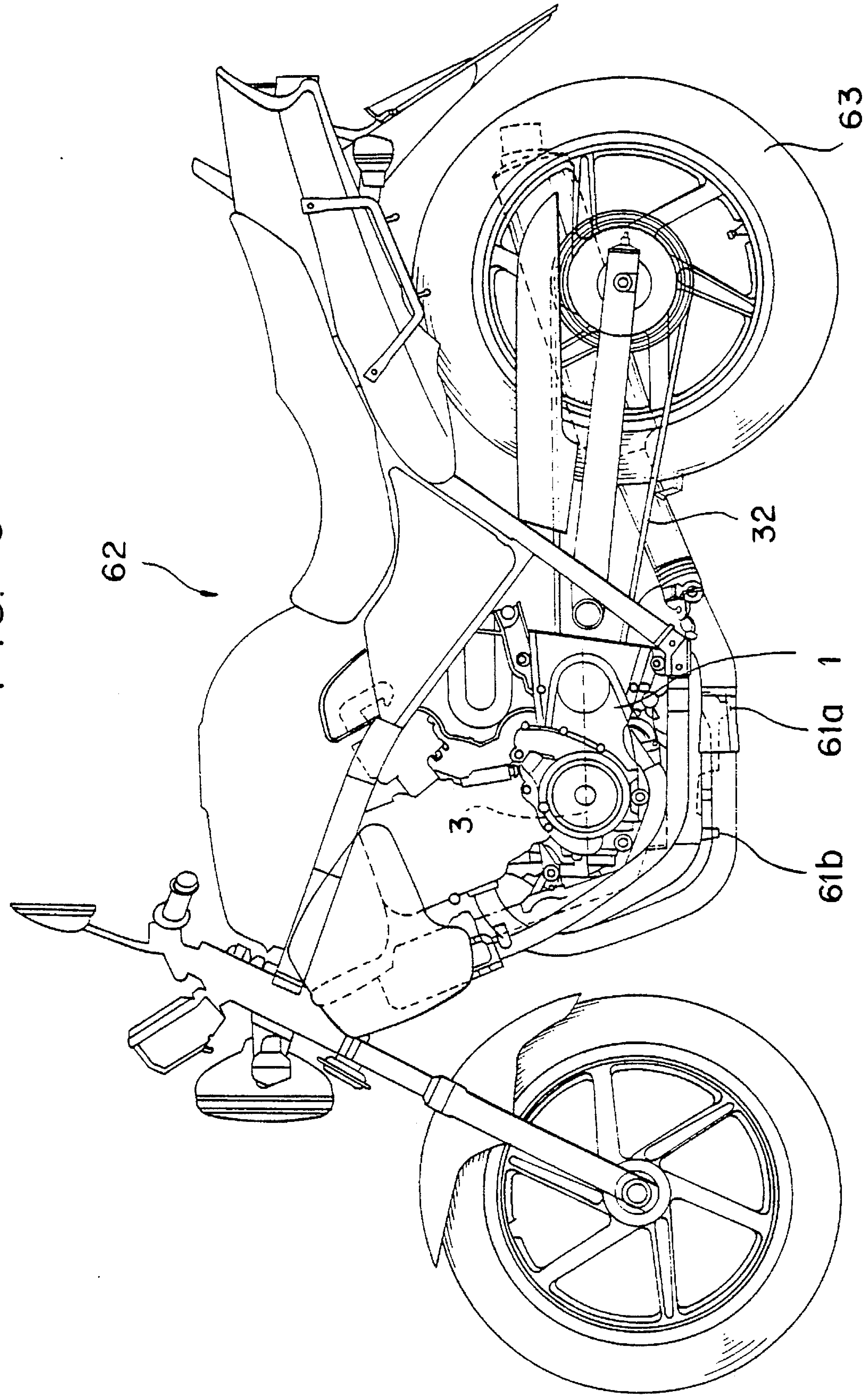


FIG. 10

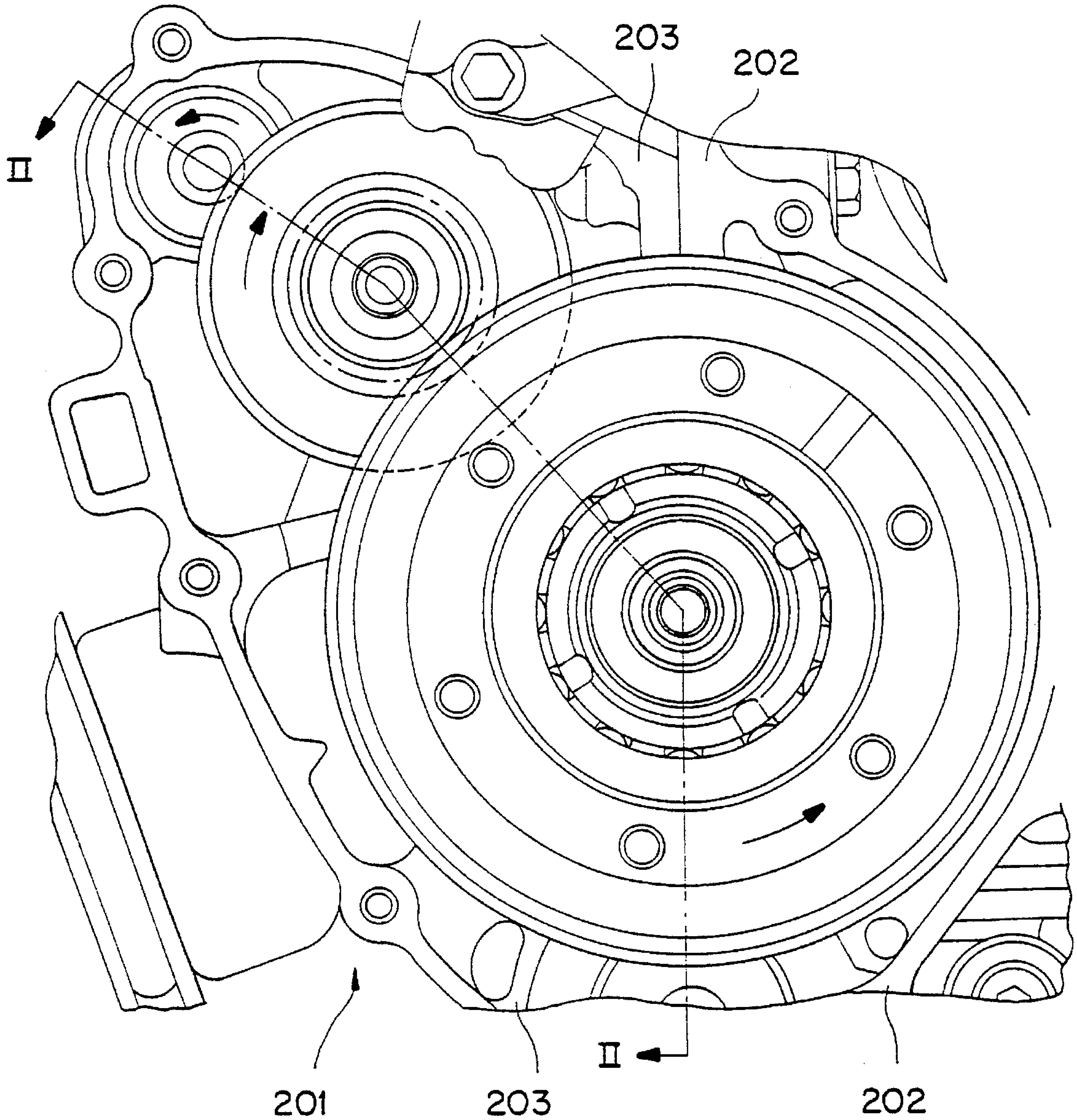
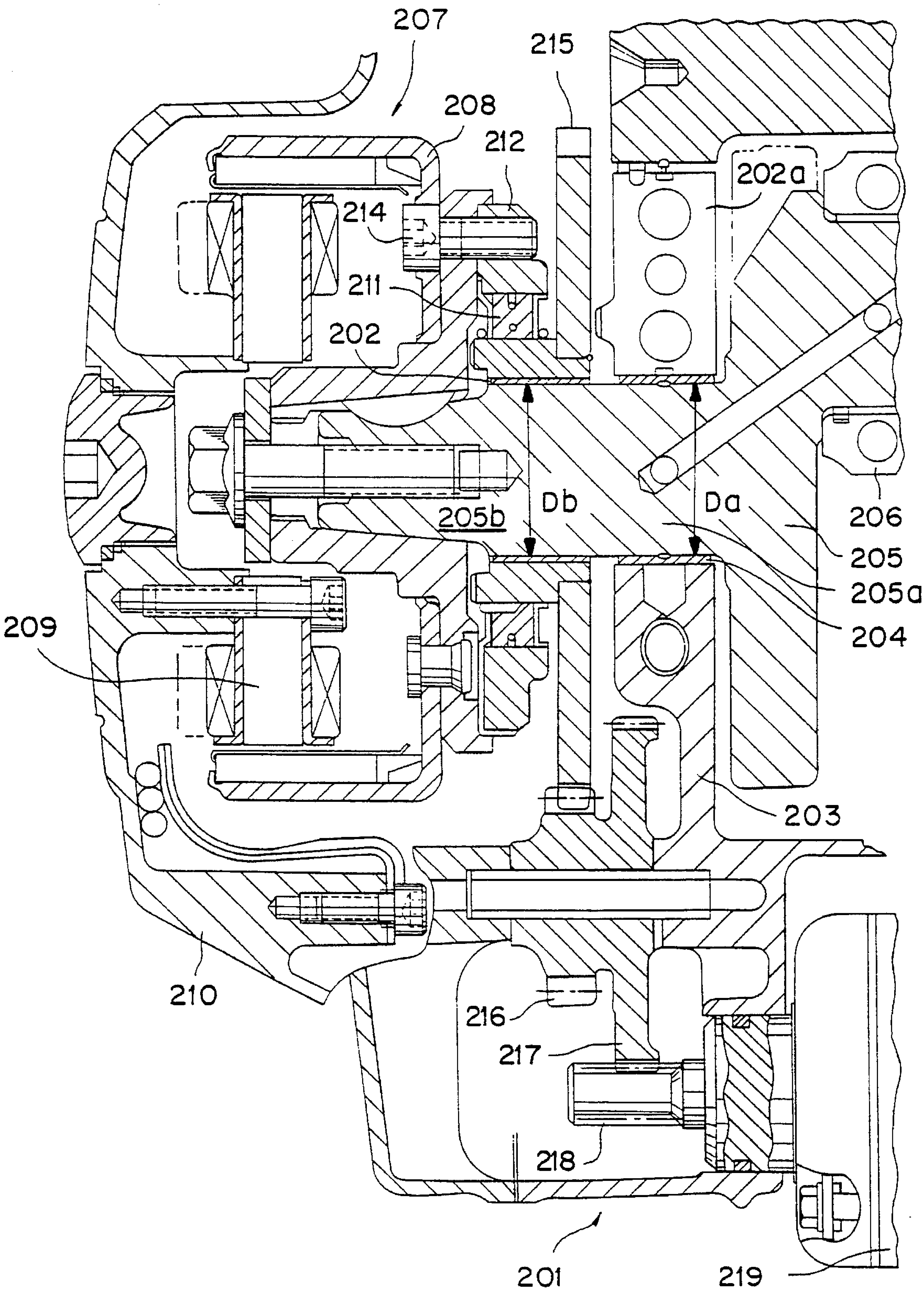


FIG. 11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212
202a
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211
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205b
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201
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FIG. 12

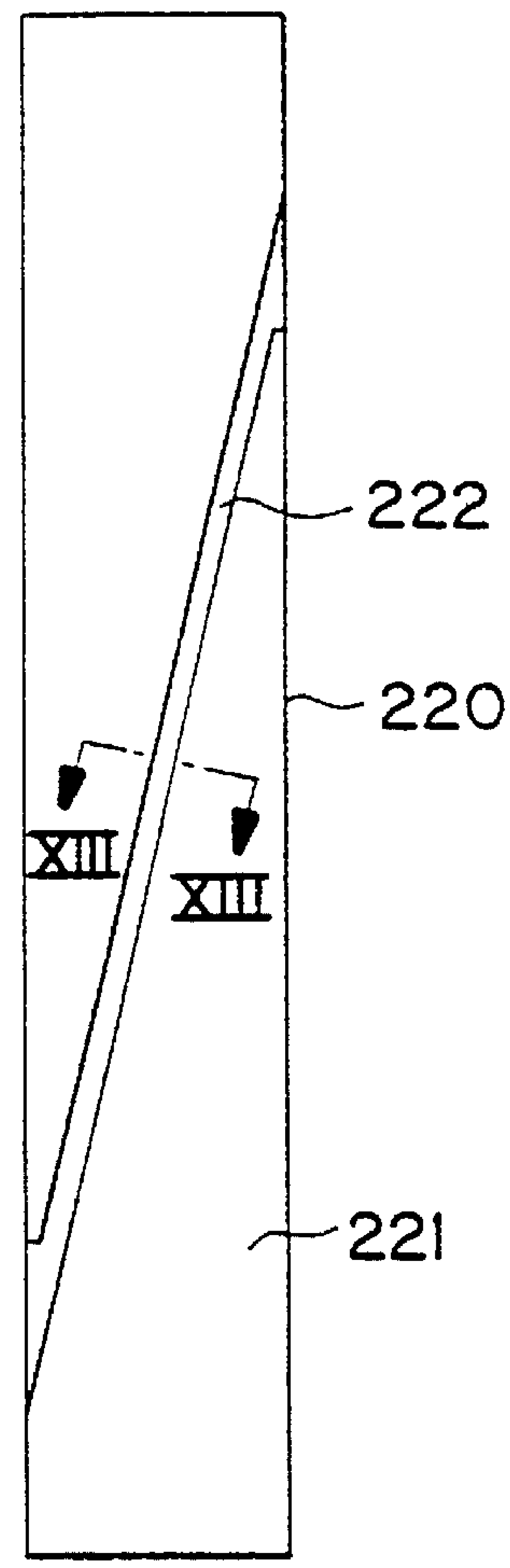


FIG. 13

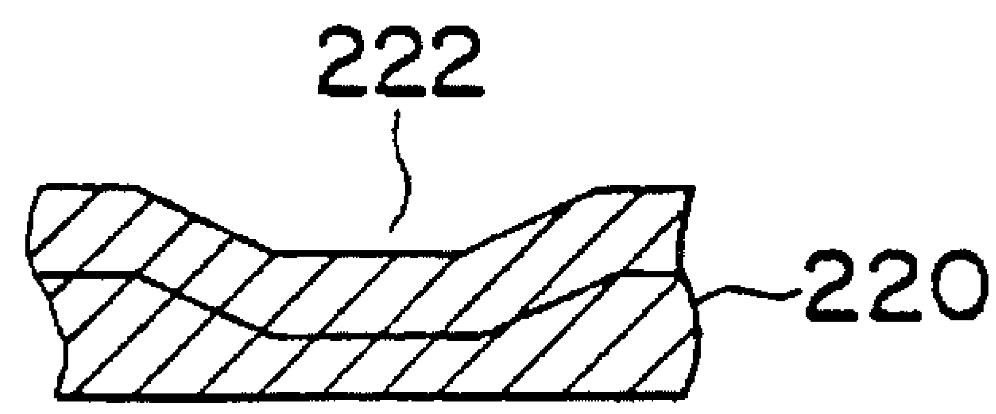


FIG. 14
PRIOR ART

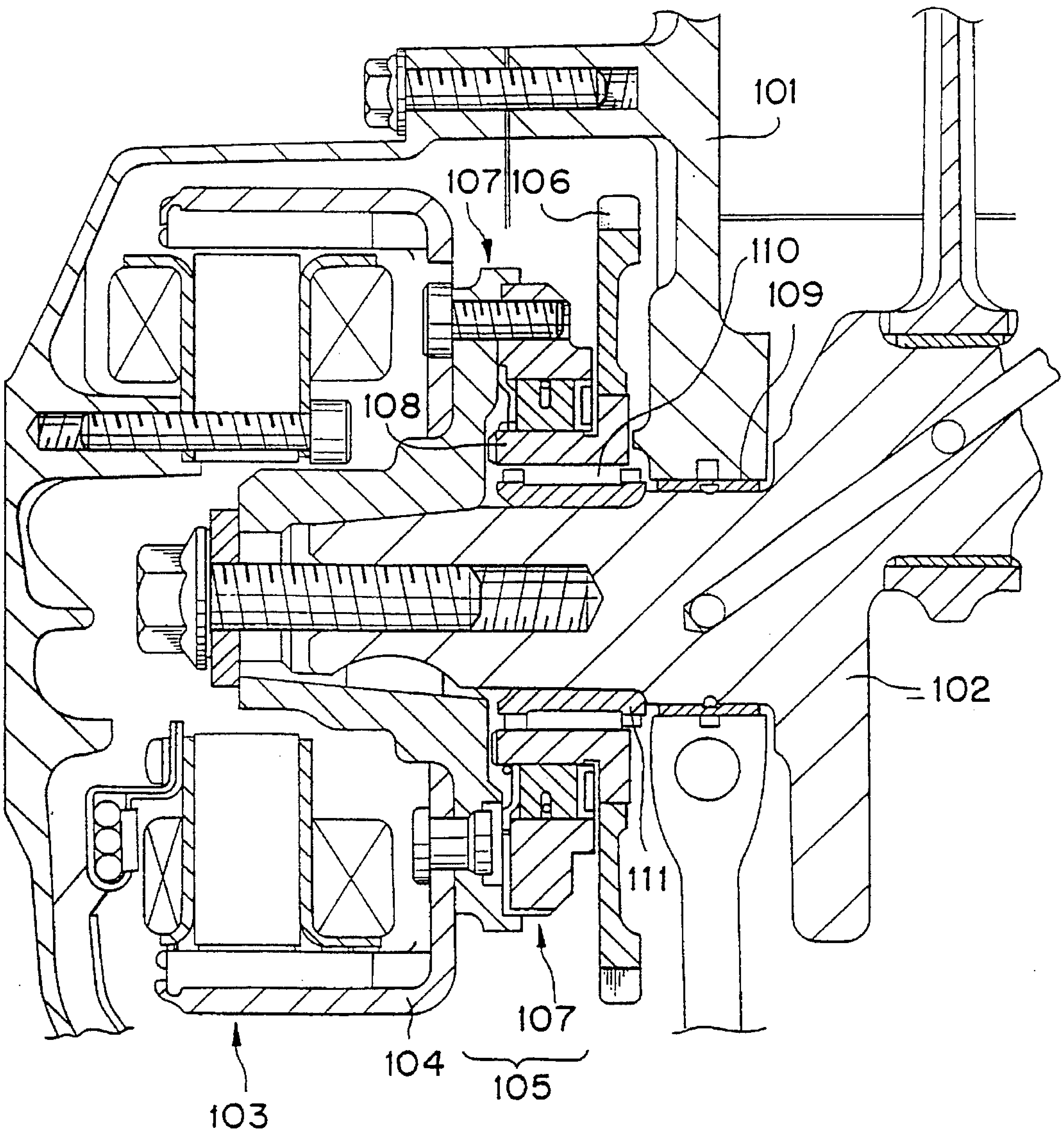
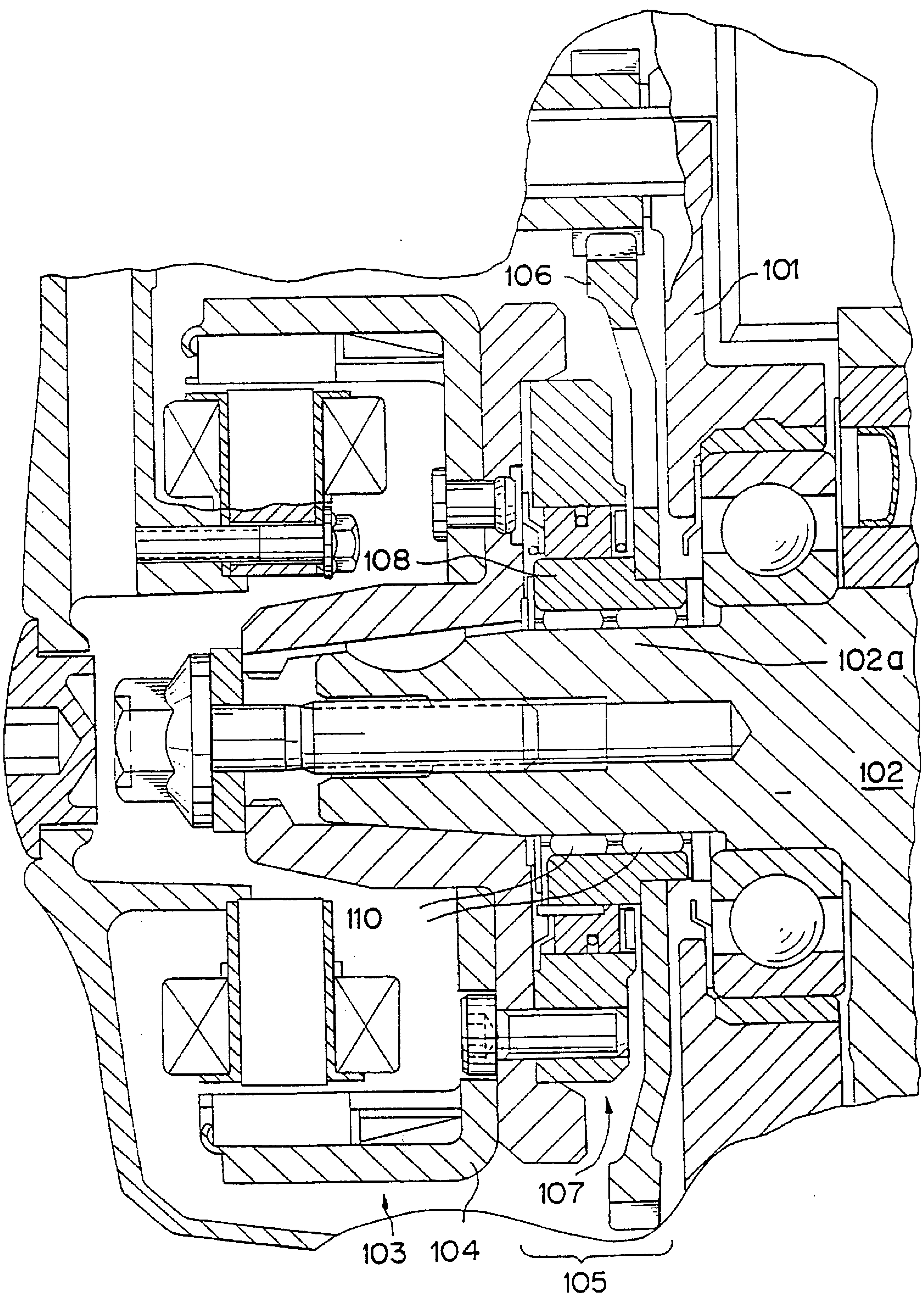


FIG. 15
PRIOR ART



LUBRICATING OIL FEEDING APPARATUS AND OIL FEEDING STRUCTURE FOR STARTER DRIVEN GEAR BEARING IN INTERNAL COMBUSTION ENGINE

This application is a divisional of copending application Ser. No. 08/297,826, filed on Aug. 30, 1994, the entire contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an internal combustion engine including a balancer shaft rotated in synchronization with a crankshaft, and particularly to an apparatus for feeding lubricating oil to the crankshaft and the balancer shaft of the internal combustion engine. In addition, the present invention relates to an oil feeding mechanism for a starter driven gear bearing, wherein a starter driven gear is disposed on a crankshaft of an internal combustion engine.

2. Description of Background Art

To suppress the vibration of an engine, a balancer shaft having an eccentric weight has been disposed in parallel to a crankshaft and rotated in synchronization with the balancer shaft.

The lubrication for each bearing of the balancer shaft has been made as follows. An accessary part such as an orifice, jet, or control bolt composed of a bolt for mounting a pipe which is perforated, is provided in an oil passage branched from a lubricating oil main gallery communicated to an lubricating pump. The oil feeding for each bearing is made by way of the above part, and further the amount of oil fed to each bearing is adjusted by the part.

In an internal combustion engine disclosed in Unexamined Japanese Patent Publication No. HEI 2-211327, a central oil passage and side oil passage are provided under a crankshaft and a balancer shaft so as to be parallel to these shafts, and these oil passages are communicated to each other by way of a communication oil passage. Oil passages are provided between the central oil passage and each bearing of the crankshaft, and between the side oil passage and each bearing of the balancer shaft. One of these oil passages is connected to a lubricating oil pump.

The above-described lubricating oil feeding apparatus using the orifice or the like is disadvantageous in that the lubricating oil passage is complicated and thereby the number of parts is increased. Also screwing and assembling are required for inserting the orifice or the like and thereby the number of processing steps is increased. Another disadvantage lies in that since the flow of the lubricating oil is restricted by the orifice or the like before reaching the oil hole of the bearing, it takes a lot of time for the lubricating oil to reach the interior of the bearing after starting of the engine.

In the lubricating oil feeding apparatus disclosed in Unexamined Japanese Patent Publication No. HEI 2-211327, the construction of the oil passage is relatively simple, and the number of parts is small; however, it is difficult to suitably adjust the amount of oil fed to each bearing. Namely, to effectively utilize the lubricating oil, it is required that the amount of oil fed to each bearing of the balancer shaft to which a relatively small load is applied is made smaller than the amount of oil fed to each bearing of the crankshaft to which a large load is applied. The above lubricating oil feeding apparatus, however, cannot meet such a requirement.

There has been known an internal combustion engine mounted on a motorcycle of a type in which, as shown in FIGS. **14** and **15**, a rotor **104** of a power generator **103** is integrally mounted at the leading edge of a crankshaft **102** projecting sideward from a crankcase **101**, and a starter system **105** is disposed between the rotor **104** and the crankcase **101**.

In this starter system **105**, a starter driven gear **106**, which is rotated in the starting direction by way of a starter motor and an intermediate gear (not shown), is adapted to transmit the starting torque to the rotor **104** and the crankshaft **102** by way of a one-way clutch **107**. In operation of an internal combustion engine, the starter driven gear **106** is stopped along with the stoppage of the starter motor, and thereby the starter driven gear **106** is rotated relative to the crankshaft **102**. Accordingly, a bearing is required to be provided between the crankshaft **102** and the starter driven gear **106**. The above bearing cannot have a structure of forcibly supplying lubricating oil as in a slide bearing **109** of the crankshaft **102**, and it is constituted of a needle bearing **110**.

In the needle bearing **110** of the starter one-way clutch **107** shown in FIG. **14**, an inner race **111** is used. On the contrary, as shown in FIG. **15**, the inner race **111** is replaced by a starter driven gear bearing portion **102***a* of the crankshaft **102** which is subjected to high frequency quenching. The latter is disadvantageous in increasing the number of the processing steps, resulting in increased cost.

SUMMARY AND OBJECTS OF THE INVENTION

According to the present invention, a lubricating oil feeding apparatus is used for an internal combustion engine and includes a balancer shaft rotated in synchronization with a crankshaft in a vertically split crankcase. The feeding apparatus comprises plain bearings for rotatably supporting the crankshaft and the balancer shaft on a split surface of the crankcase. The plain bearings having oil holes provided therein. An oil pump for pumping lubricating oil is provided as well as generally parallel oil passages communicating with the oil holes provided in said plain bearings for exclusively feeding lubricating oil to at least said crankshaft and said balancer shaft from the oil pump. An opening area of the oil holes in the oil passages for the balancer shaft is smaller than an opening area of the oil holes in the oil passages provided in said plain bearing for said crankshaft.

Further according to the present invention, since any accessary part such as an orifice, jet or the like is not provided in an oil passage, it becomes possible to reduce the number of parts, and the number of processing and assembling steps.

Since the opening area of the oil hole of the plain bearing on the balancer shaft side is made smaller than that of the oil hole of the plain bearing on the crankshaft side, the lubricating oil can be effectively fed to the balancer shaft and crankshaft sides by the amounts corresponding to the loads.

Because each bearing is provided on the split surface of the crankcase, the shape of the oil passage is simplified, and the length thereof is shortened. Moreover, since the amount of oil fed to each bearing is controlled by the oil hole which is equivalent to the outlet of the oil passage, the time required for the lubricating oil to reach the plain bearing after starting of the engine is shortened, resulting in the increased durability of the bearing.

A further object of the present invention is to solve the above problem and to improve a starter driven gear bearing of an internal combustion engine. To achieve this object, according to the present invention, an oil feeding structure is provided for a starter driven gear bearing in an internal combustion engine of a type in which a crankshaft supporting portion is rotatably supported by a crankcase, and a starter driven gear is disposed on a driven gear shaft portion provided on the outer end side of the crankshaft supporting portion, characterized in that the outside diameter of the crankshaft supporting portion rotatably supported by the crankcase is set to be the same as that of the driven gear bearing shaft portion; the crankshaft supporting portion is disposed near the driven gear shaft portion; and a lead groove is provided in the receiving surface of a slide bearing press-fitted in the starter driven gear bearing portion.

According to the present invention having the above construction, lubricating oil fed to the crankshaft supporting portion is allowed to axially flow in the driven gear bearing portion, thus sufficiently lubricating the driven gear bearing portion with the lubricating oil.

In the present invention, the driven gear bearing portion can be sufficiently lubricated without a special lubricating oil feeding mechanism, and thereby it is possible to eliminate the necessity of providing an expensive needle bearing, and hence to reduce costs and lower the weight.

Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

FIG. **1** is a side view showing the whole construction of an internal combustion engine for a motorcycle according to one embodiment of the present invention;

FIG. **2** is a view showing an oil passage member provided in a crankcase lower portion and in the interior of an oil pan together with an oil pump and a gear transmission;

FIG. **3** is a sectional view of an essential portion substantially taken along the line III—III of FIG. **1**;

FIG. **4** is a vertical sectional view showing the vicinity of a balancer shaft including the axis of the balancer shaft;

FIG. **5** is a vertical sectional view showing the central portion of the crankshaft lower portion;

FIG. **6** is a sectional view showing a plain bearing portion of a crankshaft;

FIG. **7** is a sectional view showing a plain bearing portion of a balancer shaft;

FIG. **8** is a view showing the whole construction of a lubricating oil feeding system;

FIG. **9** is a side view showing the whole construction of a motorcycle mounting an internal combustion engine;

FIG. **10** is a side view of an essential portion showing one embodiment of an oil feeding structure for a starter driven gear bearing in an internal combustion engine according to the present invention;

FIG. **11** is a vertical sectional view taken along the line II—II of FIG. **10**;

FIG. **12** is a development of the inner peripheral surface of a slide bearing pivotally supporting a starter driven bearing portion **5*b*** of a crankshaft **5**;

FIG. **13** is a traverse sectional view of an essential portion taken along the line XIII—XIII of FIG. **12**;

FIG. **14** is a vertical sectional view showing a prior art starter driven gear bearing structure; and

FIG. **15** is a vertical sectional view showing another prior art starter driven gear bearing structure.

PREFERRED EMBODIMENTS OF THE INVENTION

FIG. **1** is a side view showing the whole construction of an internal combustion engine **1** of a motorcycle according to one embodiment of the present invention. In this figure, numeral **2** designates a crankcase, which is split into an upper crankcase portion **2*a*** and a lower crankcase portion **2*b*** along a split surface **3**. These crankcase portions **2*a*** and **2*b*** are integrally fastened by means of bolts **4**. The upper crankcase portion **2*a*** is formed integrally with a cylinder block **5**. A cylinder head **6**, a head cover **7**, an intake pipe **8** and a carburetor **9** are provided.

An oil pan **10** is connected to the bottom surface of the lower crankcase portion *2b*, and an oil filter **11** is projectingly provided on the front surface of the lower crankcase portion **2*b***. An oil pump (lubricating oil pump) **16** is disposed in the lower crankcase portion **2*b***.

A balancer shaft **12**, a crankshaft **13**, a spindle **14** and an output shaft **15** of a gear transmission are arranged in the lateral direction from the front side to the rear side while extending in the horizontal direction. These shafts **12** to **15** are rotatably supported on the split surface by bearings.

Cam shafts **17** and **17** for driving an intake valve and exhaust valve are disposed on the upper surface of the cylinder head **6** in parallel to each other.

FIG. **2** is a view showing an oil passage member provided in the lower portion of the crankcase **2** and within the oil pan **10**, the oil pump **16** to which the oil passage member is connected, and a gear transmission **18** having the spindle **14** and the output shaft **15**. The oil passage member is shown in the side section; the oil pump **16** is shown in the section taken along the line IIA to IIA of FIG. **1**; and the gear transmission **18** is shown in the section taken along the line IIB—IIB of FIG. **1**.

A suction port **19** of the oil pump **16** is communicated to the bottom portion of the oil pan **10** by way of a suction pipe **20** and a straightener **21**, and a discharge port **22** is communicated to the oil filter **11** by way of a discharge pipe **23**. A relief valve **24** for returning excessive discharge oil into the oil pan **10** is connected to the discharge pipe **23**. The relief valve **24** is surrounded by a rib **25** for preventing the stored oil in the oil pan **10** from being bubbled by the returned oil.

A lubricating oil is fed from the oil pump **16** to the oil filter **11** by way of the discharge pipe **23**, being filtered in the oil filter **11**. The oil then flows in a main gallery **26** extending from the oil filter **11** to the interior of the crankcase **2**. The main gallery **26** extends in the direction perpendicular to the balancer shaft **12** and the crankshaft **13** under these shafts **12** and **13**.

An oil feeding passage **27**, which is upwardly branched from the main gallery **26** at the leading edge of the main gallery **26**, is communicated to an oil passage **28***a* perforated in a case wall portion of the gear transmission **18**. The lubricating oil fed in the oil passage **28***a* by way of the oil feeding passage **27** flows in oil passages **28***b* and **28***c* vertically perforated in the spindle **14** and the output shaft **15** for lubricating the desired portions near the shafts.

The rotation of the crankshaft **13** is transmitted to the spindle **14** by way of a driven gear **29** and a clutch **30**, and the rotation of the spindle **14** is transmitted to the output shaft **15** at the desired gear ratio by way of a gear train which is suitably selected. The rotation of the output shaft **15** is, as shown in FIGS. **2** and **9**, transmitted to a rear wheel **63** of a motorcycle **62** by way of a sprocket **31** and a chain **32**. A sprocket **33**, which is integrally rotated with the driven gear **29**, is mounted on the spindle **14**, and a chain **35** is wound between the sprocket **33** and a sprocket **34** provided on the shaft of the oil pump **16**. Accordingly, the oil pump **16** is driven by the crankshaft **13** by way of the driven gear **29**, sprocket **33**, chain **35** and sprocket **34**.

At the intermediate portion of the main gallery **26**, that is, at the position directly under the crankshaft **13**, a first oil gallery **36** for the crankshaft is laterally branched from the main gallery **26**. FIG. **3** is a sectional view of an essential portion taken along the line III—III of FIG. **1**. As is apparent from this figure, the first oil gallery **36** for crankshaft extends on both sides of the main gallery **26** in parallel to the crankshaft **13**.

As is apparent from FIG. **3**, the internal combustion engine of this embodiment is a two cylinder engine, and two pistons **37** are connected to the crankshaft **13** by way of connecting rods **38**. The crankshaft **13** is rotatably supported on the crankcase **2** by four plain bearings **39***a*, **39***b*, **39***c* and **39***d*. These plain bearings **39***a* to **39***d* are provided along the split surface **3** of the upper crankcase portion **2***a* and the lower crankcase portion **2***b* so as to be crossed between both the portions **2***a* and **2***b*.

A drive gear **40** meshing with the driven gear **29** is provided at the right end of the crankshaft **13** (FIG. **3**), and a sprocket **41** for driving the cam shaft **17** by way of a chain is provided at the intermediate portion of the crankshaft **13**. A fly wheel **42** is provided at the left end of the crankshaft **13**, and a starting gear **44** is connected to the fly wheel **42** by way of a one-way clutch **43**.

Vertically extending oil passages **46** are respectively perforated in the bearing ribs **45***a* to **45***d* provided on the lower crankcase portion **2***b* for supporting the plain bearings **39***a* to **39***d*, and which are communicated to the first oil gallery **36** for crankshaft. The upper end of each oil passage **46** is communicated to an oil hole **47** provided on the corresponding plain bearing **39** (FIG. **6**), so that the contact surface between the plain bearing **39** and the crankshaft **13** is lubricated by the lubricating oil fed from the oil passage **46** to the inner surface of the plain bearing **39** by way of the oil hole **47**. Part of the lubricating oil after lubricating each plain bearing **39** is discharged from the plain bearing **39** into the crankcase **2** and is circulated to the oil pan **10**.

However, part of the lubricating oil after lubricating the plain bearing **39***a* is led to a crank pin bearing **49** by way an oil passage **48** perforated in the crankshaft **13** for lubricating the crank pin bearing **49**. Similarly, part of the lubricating oil after lubricating the plain bearing **39***c* is led to the other crank pin bearing **49***a* for lubricating the crank pin bearing **49***a*. Moreover, part of the lubricating oil discharged from the plain bearing **39***a* reaches the portion of the one-way clutch **43** along the crankshaft **13** for lubricating the portion. On the other hand, part of the lubricating oil discharged from the plain bearing **39***d* enters an oil hole **50** provided in the drive gear **40** for lubricating a portion between the drive gear **40** and a gear piece **40***a* additionally provided outside the drive gear **40** for removing the backlash. A recessed portion **51** is provided on the side surface facing to the plain bearing **39***d* of the drive gear **40** for positively collecting the lubricating oil in the oil hole **50**.

An upwardly extending oil passage **52** is perforated in a the bearing rib of the upper crankcase portion **2***a* corresponding to the plain bearing **39***b*. The oil passage **52** is communicated to the oil passage **46** of the bearing rib **45***b* while bypassing the plain bearing **39***b*. The oil passage **52** is, at the upper side, connected to an oil passage **53** provided along both the cam shafts **17** and **17**, so that the specified portions around the cam shafts **17** and **17** are lubricated by the lubricating oil fed to the cam shafts **17** and **17** by way of the oil passages **46**, **52** and **53**.

FIG. **4** is a vertical sectional view showing the vicinity of the balancer shaft **12** including the axis of the balancer shaft **12**. Like the crankshaft **13**, the balancer shaft **12** is rotatably supported by plain bearings **54** and **54** provided on the split surface **3** of the crankcase. The balancer shaft **12** extends so as to be adjacent and in parallel to the crankshaft **13**, and is rotated in synchronization with the crankshaft **13** by the driven gear **55** provided at the end portion of the balancer shaft **12** so as to mesh with the drive gear on the crankshaft **13** side.

A second oil gallery **56** for the balancer shaft is disposed in parallel to and under the balancer shaft **12**. The second oil gallery **56** does not directly cross to the main gallery **26**, unlike the first oil gallery **36** for the crankshaft **13**, and as shown in FIG. **5**, it extends perpendicularly to the main gallery **26** at the position higher than that of the main gallery **26**, that is, at the position near the balancer shaft **12**. The second oil gallery **56** for balancer shaft and the main gallery **26** are communicated to each other by a vertically extending communicating passage **57**. The axis of the communication passage **57** is shifted to the crankshaft **13** side with respect to the axis of the second oil gallery **56** for the balancer shaft. Thus, the position of the outer end of the main gallery **26** can be also shifted to the crankshaft **13** side, so that the projecting length of the oil filter **11**, connected to the outer end, from the engine main body can be shortened. Moreover, the weight of the portions near the oil passage of the crankcase can be reduced, and the rigidity of the portions near the balancer shaft can be increased by provision of the special oil passage near the balancer bearing.

Oil passages **58** are branched from both the ends of the second oil gallery **56** for balancer shaft and extend upwardly. The oil passages **58** reach the plain bearings **54** at both the ends of the balancer shaft **12**, and are communicated to the oil holes **59** provided in the plain bearings **54** (FIG. **7**). The opening area of the oil hole **59** is made smaller than that of the oil hole **47** of the plain bearing **39** on the crankshaft **13** side.

Like the drive gear **40** on the crankshaft **13** side, a gear piece **55***a* is additionally provided on the driven gear **55**. Moreover, like the oil hole **50** and the recessed portion **51**, an oil hole **50***a* and a recessed portion **51***a* are provided in the driven gear **55**. An oil pressure switch **60** is mounted at one end of the second oil gallery **56** for the balancer shaft.

FIG. **8** shows the whole of the lubricating oil feeding system described above. The lubricating oil discharged from the oil pump **16** reaches the main gallery **26** by way of the discharge pipe **23** and the oil filter **11**. Part of the lubricating oil is forcibly fed from the main gallery **26** to each plain bearing **39** of the crankshaft **13** by way of the first oil gallery **36** for crankshaft and the oil passage **46**. On the other hand, part of the lubricating oil is forcibly fed to each plain bearing **54** of the balancer shaft **12** by way of the second oil gallery **56** and the oil passage **58**. Namely, the lubricating oil is fed to the plain bearings **39** and **54** in a parallel manner, and thus reaches each plain bearing substantially at an equal pressure. Accordingly, the amount of the lubricating oil fed to each plain bearing is mainly dependent on the opening area of the oil hole **47** or **59**. Namely, a large amount of the lubricating oil is fed to the plain bearing **39** including the oil hole **47** having the large opening area compared with the plain bearing **54** including the oil hole **59** having the small opening area. Therefore, it becomes possible to feed the lubricating oil to the plain bearing **39** on the crankshaft **13** side which is large in the bearing load and requires a relatively large lubricating oil, and to the plain bearing **54** on the balancer shaft **12** side which is small in the bearing load and requires only a relatively small lubricating oil, by the suitable amounts.

Moreover, the adjustment of the oil amount is performed only by changing the opening area of the oil hole **47** or **59**, and thereby the oil amount adjustment member such as an orifice, jet or the like is eliminated. This makes it possible to simplify the construction of the lubricating oil feeding system, and to reduce the number of parts and the number of the processing and assembling steps.

The resistance of the oil passage extending from the oil pump **16** to the plain bearings **39** and **54** is small, and thereby the lubricating oil can rapidly reach the plain bearings **39** and **54** after starting of the engine.

As shown in FIG. **1**, the oil pan **10** is formed such that the rear portion on which the straightener **21** is provided is deep and the front portion is shallow. As a result, the bottom portion of the oil pan **10** is low at the rear portion and is high at the front portion. Self-rising feet **61***a* and **61***b* are provided at the rear portion and the front portion of the bottom portion of the oil pan **10**, respectively. In performing the maintenance for the single engine, the whole of the internal combustion engine **1** can be self-raised by the self-rising feet **61***a* and **61***b*.

The internal combustion engine **1** is mounted on a motorcycle **62** in the state that the split surface **3** is horizontally kept as shown in FIG. **9**, that is, in the same state as shown in FIG. **1**. In maintenance, for self-raising the internal combustion engine **1** in the state that the split surface **3** is kept substantially in the horizontal direction, the front self-rising foot **61***b* must be lengthened. However, in this embodiment, the self-rising foot **61***b* is shortened, and the internal combustion engine **1** is self-raised in the state to be tilted forwardly by an angle α.

According to the present invention, the construction of the lubricating oil feeding system is simplified, and the number of parts and the number of processing and assembling steps are reduced. Moreover, since the lubricating oil can be fed to the plain bearing on the balancer shaft and the crankshaft sides by specified amounts, it becomes possible to effectively utilize the lubricating oil, to shorten the time required for feeding oil to each portion, and to improve the durability of the bearing.

Hereinafter, an embodiment of the present invention will be described with reference to FIGS. **10** to **13**.

As shown in FIGS. **10** and **11**, an overhead-valve cam type two cylinder/four cycle internal combustion engine **201** has a crankshaft **205** pivotally supported between a lower half crankcase **202** and a cylinder block **203** serving as an upper half crankcase by way of a slide bearing **204**, and a cylinder head and a head cover (not shown) are overlapped and integrally joined to each other over the cylinder block **203**.

The crankshaft **205** is connected, by way of a connecting rod **206**, to a piston (not shown) which is fitted in a cylinder (not shown) of the cylinder block **203** so as to be freely reciprocated in the vertical direction. The crankshaft **205** is rotated according to the ascending/descending motion of the piston.

A rotor **208** of a generator **207** is integrally fitted at the left end of the crankshaft **205**, and a stator **209** opposed to the rotor **208** is integrally mounted on a crank cover **210**.

An outer portion **212** of the starter one-way clutch **211** is integrally fitted to the rotor on the inner side of the vehicular body by means of bolts **214**. The starter driven gear **215** is connected to the starter drive gear **218** of a starter motor **219** by way of intermediate gears **216** and **217**. When the starter drive gear **218** is rotated in the starting direction (counterclockwise in FIG. **10**) by the starter motor **219**, the starter driven gear **215** is rotated in the same direction, so that the starter one-way clutch **211** is in the power transmission state, and the outer portion **212** is rotated in the same direction, thus rotating the crankshaft **205** in the starting direction by way of the rotor **208** of the generator **207**.

The diameter D_b of the starter driven gear bearing portion **205***b* of the crankshaft **205** is set to be the same as the diameter D_a of a supporting portion **205***a* of the crankshaft **205**. The starter driven gear **215** on the inner side of the starter one-way clutch **211** is fitted to the starter driven gear bearing portion **205***b* of the crankshaft **205** so as to be freely rotated relative to the starter driven gear bearing portion **205***b* by way of a slide bearing **220** press-fitted in the starter driven gear **215**.

A spiral lead groove **222** which is tilted outwardly in the rotational direction of the crankshaft **205** is formed on the inner peripheral surface of the slide bearing **220**.

An oil passage (not shown) for feeding a lubricating oil to the slide bearing **204** is formed in the supporting portion **202***a* of the crankcase **202** for supporting the crankshaft **205**, and the lubricating oil fed from the oil passage (not shown) to the slide bearing **204** axially flows out or blows off along the surface of the supporting portion **205***a* of the crankshaft **205**. The lubricating oil is drawn by the lead groove **222** provided in the slide bearing **220**, and is made to positively flow between the starter driven gear bearing portion **205***b* of the crankshaft **205** and the slide bearing **220**.

In the embodiment shown in FIGS. **10** to **13**, when the starter motor **219** is operated and the starter drive gear **218** is rotated counterclockwise as shown in FIG. **10**, the starter driven gear **215** is rotated in the same direction. As a result, the starter one-way clutch **211** is in the power transmission state, and the outer portion **212**, rotor **208** and crankshaft **205** are rotated in the same direction, thus starting the four cycle internal combustion engine **201**.

When the four cycle internal combustion engine **201** is started, the rotational speed of the crankshaft **205** is larger than that of the starter driven gear **215** by the starter motor **219**, so that the power is not transmitted from the starter one-way clutch **211** to the starter driven gear **215**. Thus, when the starter motor **219** is stopped, the starter one-way clutch **211** is in the power shielding state, and the starter driven gear **215** is left in the stopped state, so that the starter driven gear **215** is rotated relative to the crankshaft **205**.

The diameter D_a, of the supporting portion **205***a* of the crankshaft **205** is the same as the diameter D_b of the starter driven gear bearing portion **205***b* of the crankshaft **205**. Accordingly, lubricating oil is fed from the oil passage (not shown) to the slide bearing **204** by way of the supporting portion **202***a* of the crankcase **202**, and part of the lubricating oil directed outwardly is allowed to flow out or blow off outwardly in the axial direction, and is drawn in the lead groove **222** by the rotation of the starter driven gear **215** relative to the crankshaft **205**. The slide bearing **220** is thus lubricated by the drawn lubricating oil.

Therefore, it becomes possible to eliminate the needle bearing which has been conventionally required, to significantly reduce the number of parts, to extremely reduce the cost, and to lower the weight of the motorcycle.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

What is claimed is:

1. An oil feeding structure for a starter driven gear bearing in an internal combustion engine having a crankshaft supporting portion rotatably supported by a crankcase, and a starter driven gear disposed on a driven gear shaft portion provided on an outer end side of said crankshaft supporting portion, the oil feeding structure comprising:

an outside diameter of said crankshaft supporting portion being the same as that of said driven gear bearing shaft portion;

said crankshaft supporting portion being disposed near said driven gear shaft portion; and

a lead groove in a receiving surface of a slide bearing press-fitted in said starter driven gear bearing portion.

2. The oil fed structure as recited in claim **1**, wherein said lead groove is nonparallel to a rotational direction of the crankshaft and is on an inner peripheral surface of the slide bearing.

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